

Copper Fungicides – A Comprehensive List of Products Used for Vegetable Disease Control

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Copper was one of the first elements used as a plant fungicide (the other was Sulfur). Its discovery can be traced back to the famous origin of Bordeaux mixture, containing a mixture of copper sulfate (CuSO₄) and slaked lime, and used for downy mildew control in French vineyards.

Copper compounds, 17 are detailed in this report as registered (all are underlined) in NYS, are still widely used for disease control in both conventional and organic production (6 products as listed by the **OMRI** are indicated in this report in **green**). Coppers are assigned to Group M1 by Fungicide Resistance Action Committee (FRAC), with the “M” indicating multisite activity. One product, ^{M1+M3} ManKocide, is a combination of ^{M1} *copper hydroxide* and ^{M3} *mancozeb* (MZ) to capitalize on the benefit of the mancozeb component to increase the release of Cu²⁺ ions to provide better control of bacterial diseases like speck, spot and canker of tomato. Note that this product is approved for use on Tomato, but not on Pepper or Eggplant. As long as mancozeb is labeled for a given crop, conventional growers can make their own tank-mixture of mancozeb with the copper product of their choice. Begin by choosing a copper product with at least 20% or more copper as the active ingredient to insure the greatest release of Cu²⁺ ions.

Not all copper fungicide products are created equal, as indicated by the differences in the percent of active ingredient and the formulation of copper used. A quick review of the table reveals that there can be major differences between the products and the diseases labeled by crop. Language can also be vague as to which diseases are actually meant, but by reviewing all of the labels some clues are provided. For example, although basic copper sulfate (Albaugh and Old Bridge) have pretty broad labels across the crops listed, under crucifers they list leaf spots (**LeafS**) along with downy mildew (**DM**), leaving us to assume that the leaf spots they mean are for Bacterial black rot (**Blkrot**) and Alternaria black leaf spot (**Alt LS**), as these diseases are shown on all other labels. For cucurbits, **2ee labeling exists for some coppers registered in New York specifically for Phytophthora blight (PhyBlt)** as indicated (**the same also applies for Phyto Blight of Pepper, but are not indicated in the table**). The straight copper products are all labeled for **TEP**, = **T**omato, **E**ggplant and **P**epper. In the table, only the diseases for tomato = **T** are listed (because of space limitations), but in the footnote the diseases are covered for eggplant and pepper. Another clarification for tomato is for leaf mold caused by *Fulvia fulva*. This appears on the labels as either leaf mold (**LefMo**) or gray leaf mold (**GyLM**). The footnotes provide information on the other abbreviations. I call your attention to two additional factors summarized in the Table. Some of the more recently revised copper labels have shifted to 48 hrs as the time for re-entry (REI), while the older labels maintain 24 hrs, but a few have even shorter intervals. Most products are listed for use in the greenhouses directly on the label, and indicated in the next to last column as Yes or No.

Note: Most of the copper labels are from the PIMS web site (<http://pims.psur.cornell.edu/>), or in a few cases the latest label was found on the Crop Data Management System site (CDMS) (<http://www.cdms.net/LabelsMsds/LMDefault.aspx?ms=1>). My advice is to carefully check the label before you purchase any product to make sure it clearly lists the crops and diseases for your intended use. As always, “the label is the law”.

Listing of Copper Compounds (NYS Reg.) for Vegetables By Disease © T. A. Zitter October 2012

| <u>Trade Name (OMRI in Green)</u> | <u>Source</u> | <u>Active ingredients</u> | <u>% Metallic Cu</u> | <u>REI (Hrs.)^a</u> | <u>Beans Dry or Green</u> | <u>Crucifers^c</u> | <u>Ca. Cel. Be & Gr.^d</u> | <u>Cucurbits^e</u> | <u>Let. En. Es. Sp^f</u> | <u>On. Gar. Le^g</u> | <u>Tom. Egg. Pep^h</u> | <u>Potatoⁱ</u> | <u>GrHs On Label^j</u> | <u>Misc. Wa. Ch. Di. Pa^k</u> |
|--|---------------|---|----------------------|-------------------------------|---|------------------------------|--|---|---|--|---|---------------------------|----------------------------------|---|
| Badge SC EPA 80289-3 Aug 10, 2012 | Isagro | 16.8% copper oxychloride + 15.4% copper hydroxide Rates given in pints Limits are set per season | 20 | 48 | <u>Dr, Gr</u> Blkrot BwnSp. ComBlt HaloBlt Anth CerLS DM | Blkrot Alt LS DM | <u>All 3</u> see label | AngLS Alt LS DM PM GSB Anth | <u>Sp</u> Anth DM CerLS WhRst <u>Let</u> Anth DM LS | <u>On, G</u> BacBlt DM PurBlo | <u>TEP</u> BacSe BacSp BacCan Anth EB LB SepLS GyLM | EB LB | Yes | <u>All</u> see label |
| Badge X₂ EPA 80289-12 Mar 6, 2012 | Isagro | 23.8% copper oxychloride + 21.5% copper hydroxide Rates given in lbs. Limits are set for season | 28 | 48 | <u>Dr, Gr</u> Same as above | Same as above | <u>All 3</u> Broader label | Same as above | <u>Let. Sp.</u> Same as above | <u>On, G</u> Same as above | <u>TEP</u> Same as above | EB LB | Yes | <u>All</u> see label |
| Basic Copper 53 EPA 45002-8 Outdated label | Albaugh | 98% basic copper sulfate Rates given in lbs. Seasonal limits not set | 53 | 24 | <u>Gr, Dr</u> AngLS BacBlt Anth DM PM | DM LeafS | <u>All 3</u> see label | AngLS Anth Alt LS DM PM GSB Scab | <u>All 4</u> Anth DM CerLS WhRst | <u>On</u> DM PurBlo | <u>TEP</u> BacSe BacSp BacCa Anth EB LB LefMo SepLS StemLS | EB LB | No | No |
| Basic Copper Sulfate EPA 46923-9 Outdated label | Old Bridge | 99% basic copper sulfate Rates given in lbs. Seasonal limits not set | 53 | 24 | <u>Gr, Dr</u> AngLS BacBlt Anth DM | DM LeafS | <u>All 3</u> see label | AngLS Anth Alt LS DM PM GSB Scab | <u>Le. Sp</u> Anth DM CerLS WhRst | <u>On</u> DM PurBlo | <u>TEP</u> BacSp BacCa Anth EB LB LefMo | EB LB | No | No |

| Trade Name (OMRI in Green) | Source | Active ingredients | % Metallic Cu | REI hrs. ^a | Beans ^b Pea | Crucifers ^c | Ca. Cel. Be & Gr ^d | Cucurbits ^e | Let. En. Es. Sp ^f | On. Gar. Le ^g | Tom. Egg. Pep ^h | Pototo ⁱ | GrHs On Label ^j | Misc. Wa. Ch. Di. Pa ^k |
|--|----------|--|---------------|-----------------------|--|-----------------------------------|-------------------------------|---|--|-------------------------------------|--|-------------------------|----------------------------|-----------------------------------|
| Camelot O EPA 67702-2-67690 Mar 11, 2011 | SePro | 10% copper octanoate Rates given in gal. Seasonal limits not set "Generic Label" Compare with Cueva | 1.8 | 4 | Generic see label | Alt BacLS DM PM WhMid | see label | see label | see label | BotLBit DM NeckRot BacSRot | TEP see label | | No | no misc! Artic. Corn |
| Champ Formula 2F EPA 55146-64 Jun 6, 2012 | Nufarm | 37.5% copper hydroxide Rates given in pints Limits are set per season | 24.4 | 48 | Gr, Dr BrnSp ComBit HaloBit DM | Blkrot Alt LS DM label | All 3 see label | AngLS Alt LS Anth DM PM GSB 2ee | Le,En,Es DM Sp Anth CerLS DM WhRst | O,G,L DM PurBlo BacBit | TEP BacSe BacSp Anth EB, SLS LB GyLM | EB LB Sup CPB | Yes | All see label PhyBit |
| Champ Dry Prill EPA 55146-57 Aug 27, 2012 | Nufarm | 57.6% copper hydroxide Rates given in lbs. Limits are set per season | 37.5 | 48 | Gr, Dr BrnSp ComBit HaloBit - | Blkrot Alt LS DM label | All 3 see label | AngLS Alt LS Anth DM PM GSB - | L,En,Es DM; Sp Anth CerLS DM WhRst | O,G,L DM PurBlo BacBit | TEP BacSe BacSp Anth EB, SLS LB GyLM | EB LB Sup CPB | Yes | All see label - |
| Champ WG EPA 55146-1 June 13, 2012 | Nufarm | 77% copper hydroxide Rates given in lbs. Limits are set per season | 50 | 48 | Gr, Dr BrnSp ComBit HaloBit | Blkrot Alt LS DM label | All 3 see label | AngLS Alt LS Anth DM PM GSB | Sp Anth WhRst DM CerLS BkLS | On,G DM PurBlo BacBit | TEP BacSe BacSp Anth EB, SLS LB GyLM | EB LB Sup. CPB | Yes | All see label |
| C-O-C-S WDG EPA 34704-326 Mar 29, 2012 | Loveland | 73.5% copper oxychloride +13.4% basic copper sulfate Rates given in lbs. Limits are set per season | 51.3 | 48F; 24 GH | Gr, Dr BacBit Anth CerLS | Blkrot DM see label | All 3 see label | Anth | L,Es,En DM Sp | On,G DM PurBlo | TEP BacSp EB LB | EB LB | Yes | No |

| | | | DM | | | | LefSp | | | SepLS | | | | |
|--|--------|--|---------------|----------------------|---|------------------------|-------------------------------|---|---|--|---|---------------------|----------------------------|--|
| | | | | | | | DM | | | | | | | |
| Trade Name (OMRI in Green) | Source | Active ingredients | % Metallic Cu | REI hrs ^a | Beans ^b | Crucifers ^c | Ca. Cel. Be & Gr ^d | Cucurbits ^e | Let. En. Es. Sp ^f | On. Gar. Le ^g | Tom. Egg. Pep ^h | Potato ⁱ | GrHs On Label ^j | Misc. Wa. Ch. Di. Pa ^k |
| Cueva Fungicide Conc. EPA 67702-2-70051 May 13, 2010 | Certis | 10% copper octanoate Rates given in gal. Seasonal limits not set "Generic Label" Compare with Camelot O | 1.8 | 4 | Yes | BLS AltLS DM | All 3 see label | AngLS AltLS DM PM GSB Uloclad | L. En. Es BacSR DM PM LeaSp | O.G.L Etc. BotLB DM NeckR BacSR | TEP Anth BSpe BSpt EB, LB GyMld Septoria | EB LB | Yes | No Artic Corn |
| Cuprofix Ultra 40 Disperss EPA 70506-201 Aug 21, 2012 | UPI | 71.1% basic copper sulfate Rates given in lbs. Limits are set per season | 40 | 48 | Dr, Gr BrnSp ComBlt HaloBlt DM | Blkrot Alt LS DM | All 3 see label | AngLS Alt LS Anth DM PM GSB 2ee PhyBlt | Sp Anth DM CerLS WhRst | On, G BacBlt DM PurBlo | TEP BacSe BacSp Anth EB LB GyLM SepLS | EB LB | Yes | All see label |
| Kentan DF EPA 80289-2 Mar 2, 2012 | Isagro | 61.3% copper hydroxide Rates given in lbs. Limits are set per season | 40 | 48 | Dr, Gr BrnSp ComBlt HaloBlt Anth BacBlt CerLS DM | Blkrot Alt LS DM | All 3 see label | AngLS Alt LS Anth DM PM GSB | L.En,Es Sp Anth DM CerLS WhRst | On, G BacBlt DM PurBlo | TEP BacSe BacSp Anth EB, SLS LB GyLM BacCa | EB LB | Yes | All see label |
| Kocide 3000 EPA 352-662 (5/13/2011) Also Registered Kocide 101 (352-681) 77% Kocide 2000 (352-650) 53.8% Kocide 4.5LF (352-684) 37.5 Kocide DF (352-688) 61.4% | DuPont | 46.1 % copper hydroxide Rates given in lbs. Limits are set per season | 30 | 48 | Dr, Gr BrnSp ComBlt HaloBlt | BlkRot Alt LS DM | All 3 see label | AngLS Alt LS Anth DM PM GSB 2ee | Sp Anth DM CerLS WhRst L.En,Es DM | On, G.L BacBlt DM PurBlo - | TEP BacSe BacSp Anth EB, SLS LB GyLM | EB LB | Yes | All see label - - - PhyBlt |

| Trade Name (OMRI in Green) | Source | Active ingredients | % Metallic Cu | REI hrs ^a | Beans ^b | Crucifers ^c | Ca, Cel, Be & Gr ^d | Cucurbits ^e | Let, En, Es, Sp ^f | On, Gar, Le ^g | Tom, Egg, Pep ^h | Potato ⁱ | GrHs On Label ^j | Misc. Wa, Ch, Di, Pa ^k |
|--|-----------|---|---------------|----------------------|--|------------------------|--------------------------------------|--|--|--|--|---------------------|----------------------------|-----------------------------------|
| ManKocide EPA 352-690 Sept 6, 2012 | DuPont | 46.1% copper hydroxide + 15% mancozeb Rates given in lbs. Limits are set per season | 30 | 48 | No | No | No | ALL AngLS AltLS DM PM GSB Scab 2ee PhyBlt | No | On, Dry BacBlt BotLB DM PurBlo | T only BacSe BacSp Anth EB LB LefMo SepLS StemLS | EB LB | No | No |
| Mastercop EPA 55272-18-66222 Feb 8, 2012 | MANA | 21.46% copper sulfate pentahydrate Rates given in pints. Limits are set per season | 5.4 | 48 | Dr, Gr BrnSp ComBlt HaloBlt | BlkLS BlkRot DM | All 3 see label for Dis. | AngLS AltLS Anth DM, PM GSB | Sp Anth DM CerLS WhtRu | On, Ga BacBlt DM PurBlt | T, EP BacSpk BacSpt EB, LB LeaMid SepLS | EB LB | No | All see label |
| Nordox 75 WE EPA 48142-4 Feb 4, 2011 | Nordox AS | 83.9% cuprous oxide Rates given in lbs. Seasonal limits not set | 75 | 12 | Dr, Gr Anth HaloBlt CerLS DM | BlkLS BlkRot DM | All 3 see label for Dis. | AngLS AltLS Anth DM, PM GSB | Let DM Sp Anth DM, WtRu | On DM PurBlo | T, EP EB, LB Speck Spot Canker GyLS LeaMid SepLS | EB LB | Yes | Yes see label |
| Nu Cop 50WP EPA 45002-7 (CDMS) Also Registered but not OMRI Nu Cop 3L (42750-75) Nu Cop HB (42750-132) | Albaugh | 77% copper hydroxide Rates given in lbs. Limits are set per season Crops presented alphabetically | 50 | 48 | Bean BrnSp ComBlt HaloBlt | BlkRot AltLS DM | All 3 see label for Dis. | AngLS AltLS Anth DM PM GSB | Le, En, Es DM Sp DM Anth CerLS WhtRu | On, Ga DM PurBlo BacBlt | T, EP BacSe BacSpt EB, SLS Anth LB GyLMid | EB LB | No | All see label |

^a**REI in hrs.** = Older, unrevised labels still have 24 hrs, while newer labels are 48 hrs reentry time, but a few are 4 or 12 hrs.

^b**Beans** = Green and Dry, if NS, then not specified on label, but assume can be used per all other copper labels; **Diseases:** **Brn Sp** = Bacterial brown spot (*Pseudomonas syringae* pv. *syringae*); **Com Blt** = Common bacterial blight (*Xanthomonas campestris* pv. *phaseoli*); **Halo Blt** = Halo blight (*Pseudomonas syringae* pv. *phaseolicola*); **Others Listed:** **Angular leaf spot** = *Phaeoisariopsis griseola* (tropical); **Anthr** = Anthracnose (*Colletotrichum lindemuthianum*); **Downy mildew** = *Phytophthora nicotianae* var. *parasitica* (tropical); **Powdery mildew** = *Erysiphe polygoni* (tropical).

^c**Crucifers** = applies for most but not for all crucifer crops, see label. **Diseases:** **Blk rot** = Black rot (*Xanthomonas campestris*); **Alt Blk LS** = Alternaria black leaf spot (*Alternaria* spp.); **DM** = Downy mildew (*Peronospora parasitica*).

^d**Ca, Cel, Be & Gr** = Carrots, Celery and Beets and Beet Greens; **Diseases** for **table beets** and **greens** includes **Cercospora Leaf Spot** (*Cercospora beticola*), **Downy mildew** (*Peronospora farinosa* f. sp. *spinaciae*), and **Phoma leaf spot** (*Phoma betae*); for **carrot** they include **Bacterial leaf blight** (*Xanthomonas campestris* pv. *carotae*), **Alternaria leaf blight** (*Alternaria dauci*), and **Cercospora leaf blight** (*Cercospora carotae*); and for **celery** and **celeriac**, **Bacterial leaf spot** (*Pseudomonas syringae* pv. *apii*), **Cercospora early blight** (*Cercospora apii*), and **Septoria late blight** (*S. apiicola*).

^e**Cucurbits** = usually applies to all in plant group unless noted on label; **Diseases:** **AngLS** = Angular leaf spot (*Pseudomonas syringae* pv. *lachrymans*), **bacterial leaf spot** (*Xanthomonas campestris* pv. *cucurbitae*), **is not listed**; **Anth** = Anthracnose (*Colletotrichum orbiculare*), **AltLS** = Alternaria leaf spot (*Alternaria cucumerina*), **DM** = Downy mildew (*Pseudoperonospora cubensis*), **PM** = Powdery mildew (several species), **GSB** = Gummy Stem Blight (*Didymella bryoniae*, **sexual** and *Phoma cucurbitacearum*, **asexual**), **Scab** = (*Cladosporium cucumerinum*); **Uloclad** = (*Ulocladium cucurbitae*); **Phytophthora blight** = **PhyBlt** (*Phytophthora capsici*) **2ee label applies** for Champ 2F, Cuprofix Ultra 40Disperss, Kocide 2000, 3000, 4.5 LF and DF, and ManKocide DF.

^f**Let, En, Es, Sp** = Lettuce, Endive, Escarole, and Spinach, and will vary by copper product; **Diseases of Lettuce:** **Anth** = Anthracnose (*Microdochium panattonianum*) also **Endive** and **Escarole**, **DM** = Downy mildew (*Bremia lactucae*), **Bacterial diseases not listed** = Bacterial leaf spot (*Xanthomonas campestris* pv. *vitians*) (seed source), Marginal leaf blight (*Pseudomonas marginalis* pv. *marginalis* (ubiquitous), Varnish spot (*Pseudomonas cichorii*) (seed); **also not listed**, Septoria leaf spot (*Septoria lactucae*) (seed source); **Diseases of Spinach**, **CerLS** = Cercospora leaf spot (*Cercospora beticola*), **DM (Blue Mold)** = (*Peronospora farinosa* f. sp. *spinaciae*), and **WhRst** = White rust (*Albugo occidentalis*).

^g**On, Gar, Le** = Onion, Garlic, Leek; Most labels handle **Diseases of Onion and Garlic** and some include **Leek:** **BacBlt** = not specified, but bacteria could include *Xanthomonas* leaf blight (*Xanthomonas campestris*), Bacterial soft rot (*Erwinia carotovora* sub sp. *carotovora*), Slippery skin (*Pseudomonas gladioli* pv. *allicola*), and Bacterial canker and Sour skin (*Burkholderia cepacia*); **Diseases of Dry Bulb Onion** when using mancozeb + copper: **BacBlt** = Bacterial blight, **BotyLB** = Botrytis leaf blight (*Botrytis squamosa*), **DM** = Downy mildew (*Peronospora destructor*), and **PurBlo** = Purple blotch (*Alternaria porri*).

^h**Tom, Egg, Pep** = Tomato, Eggplant, Pepper; **Tomato:** **BacSe** = Bacterial speck (*Pseudomonas syringae* pv. *tomato*), **BacSp** = Bacterial spot (*Xanthomonas campestris* pv. *vesicatoria*), and **BacCa** = Bacterial canker (*Clavibacter michiganensis* subsp. *michiganensis*), **Anth** = Anthracnose (*Colletotrichum coccodes*), **EB** = Early blight (*Alternaria tomatophila*), **LB** = Late blight (*Phytophthora infestans*), **LefMo** = Leaf mold or **GyLM** = Gray leaf mold (*Fulvia fulva*), **SepLS** = Septoria leaf spot (*Septoria lycopersici*), **StemLS** = Stemphylium leaf spot or Gray leaf spot (*Stemphylium solani*); **Eggplant:** includes at least **Alt Blt**, **Anth** and **Phomopsis**; **Peppers:** includes **BacSp** and others add **Anth** and **Cer LS**.

ⁱ**Pot** = Potato; **Diseases of Potato:** **EB** = Early blight (*Alternaria solani*), **LB** = Late blight (*Phytophthora infestans*).

^j**GrHs** use is specifically mentioned on the label, (but according to EPA ruling, others may also be used unless specifically mentioned as prohibited)

^k**Miscl.** = Artichoke, Corn, Watercress, Chives, Dill, and Parsley. **Dis of Artichoke:** PM, Bac spot and soft rot, and bottom rot; **Diseases of Corn:** Southern leaf blight; **Diseases of Watercress:** Cercospora leaf spot (*Cercospora nasturtii*); **Diseases of Chives:** Downy mildew (*Peronospora destructor*); **Diseases of Dill:** Phoma leaf spot, Rhizoctonia foliage blight; **Diseases of Parsley:** Bacterial blight (*Pseudomonas* sp.).

Disclaimer: Please read the pesticide label prior to use. The information contained in the article is not a substitute for a pesticide label. Trade names used herein are for convenience only; no endorsement of products is intended, nor is criticism of unnamed products implied. Most of this information is historical in nature and may no longer be applicable.